Cooperative Computing & Communication Laboratory

NATO TG 12 Workshop on ‚Middleware in Mobile Networks'

Context-Awareness in Middleware for Mobile Networks

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Introduction:

Middleware

What is middleware?

*An **enabling layer of software** that resides between the **business application** and the **networked layer** of **heterogeneous** (diverse) **platforms** and **protocols**. It decouples the business applications from any dependencies on the plumbing layer, which consists of heterogeneous operating systems, hardware platforms and communication protocols. (Source: International Systems Group)*

Introduction:
Mobile Middleware

Data-Access Middleware (JDBC,…)

Message-Oriented Middleware (MQ Series, JMS,…)

Transaction Processing Middleware (X/Open, OTS, JTS…)

Desktop-Access Middleware (Citrix,…)

Object Middleware (DCOM, CORBA,…)

Mobile Middleware

Enabling Middleware
Service and device management (Jini, UPnP) etc.

Connectivity Middleware
Network gateways etc.

Front-End Middleware
Content processing for the front-end.

Back-End Middleware
Processing of back-end data (server data access).

Introduction:

Context and Context-Awareness

What is context?

*Context is **any information** that can be used to **characterize the situation** of an **entity**. An entity is a person, place, or object that is considered relevant to the **interaction** between a **user** and an **application**, including the user and applications themselves. (Source: A. K. Dey, Georgia Tech)*

Introduction:

Context-Aware Computing

Features:

◆ **Presentation**
of personalised and adapted data / information and services to the user

◆ **Automatic execution**
of a service for the user

◆ **Logging**
of context information to support later retrieval and evaluation

Introduction:
Related Work

- **MosquitoNet**: Mobile Computing Group at Stanford
- **Endeavour:** University of California in Berkeley
- **Oxygen:** MIT
- Future Computing Environments (**FCE**): Georgia Tech *-> Context Toolkit*
- **Portolano**: University of Washington at Seattle *-> Context aware computing esp. w.r.t. user interfaces*
- **2K**: University of Illinois at Urbana-Champaign (a component-based, network-centric operating system)
- **PIMA:** IBM T.J. Watson Research Center
- **Monads:** Department of Computer Science at the University of Helsinki
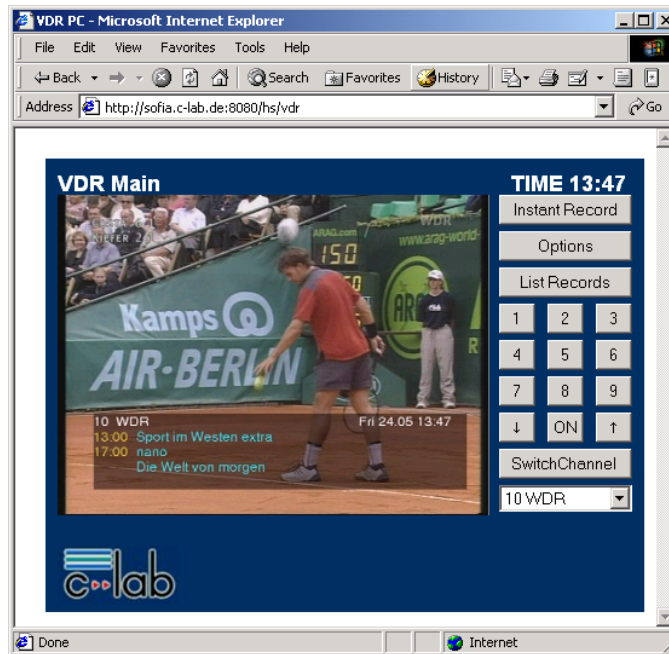
Application domain:
Home Networking

	Technology	Standard	Speed	Max. Distance
Wired	HomePNA	HomePNA v2.0	1~2/10 Mbps	150~1.5 km
	USB	USB v1.1	12 Mbps	30 m
	Ethernet	IEEE 802.3	10 M / 1 Gbps	100 m
	IEEE 1394	IEEE 1394	~400 Mbps	72 m
	Power Line	None	1~2 Mbps	100 m
Wireless	Bluetooth	Bluetooth v1.0	720 Kbps	10 m
	HomeRF	SWAP v1.2	1~2 Mbps	50 m
	IrDA	IrDA v1.3	max. 4 Mbps	1 m
	Wireless LAN	IEEE 802.11	5.5~11 Mbps	50 m

Application example:
Mobile Inhome Entertainment

Extended Home Environment (xHE)

PDA

WLAN / GSM

Server (VDR / DTV)

Web Pad

DECT

Requirements and Approach:
Middleware for Integration

Networks

Devices

Services

3G, GSM · Powerline · IP · BT · 802.11 · DECT

Domotics · Mobile · WebPad · TV · STB · PC, PDA

Radio · SMS · PKI · Profiler · WWW · TV

xHE MW
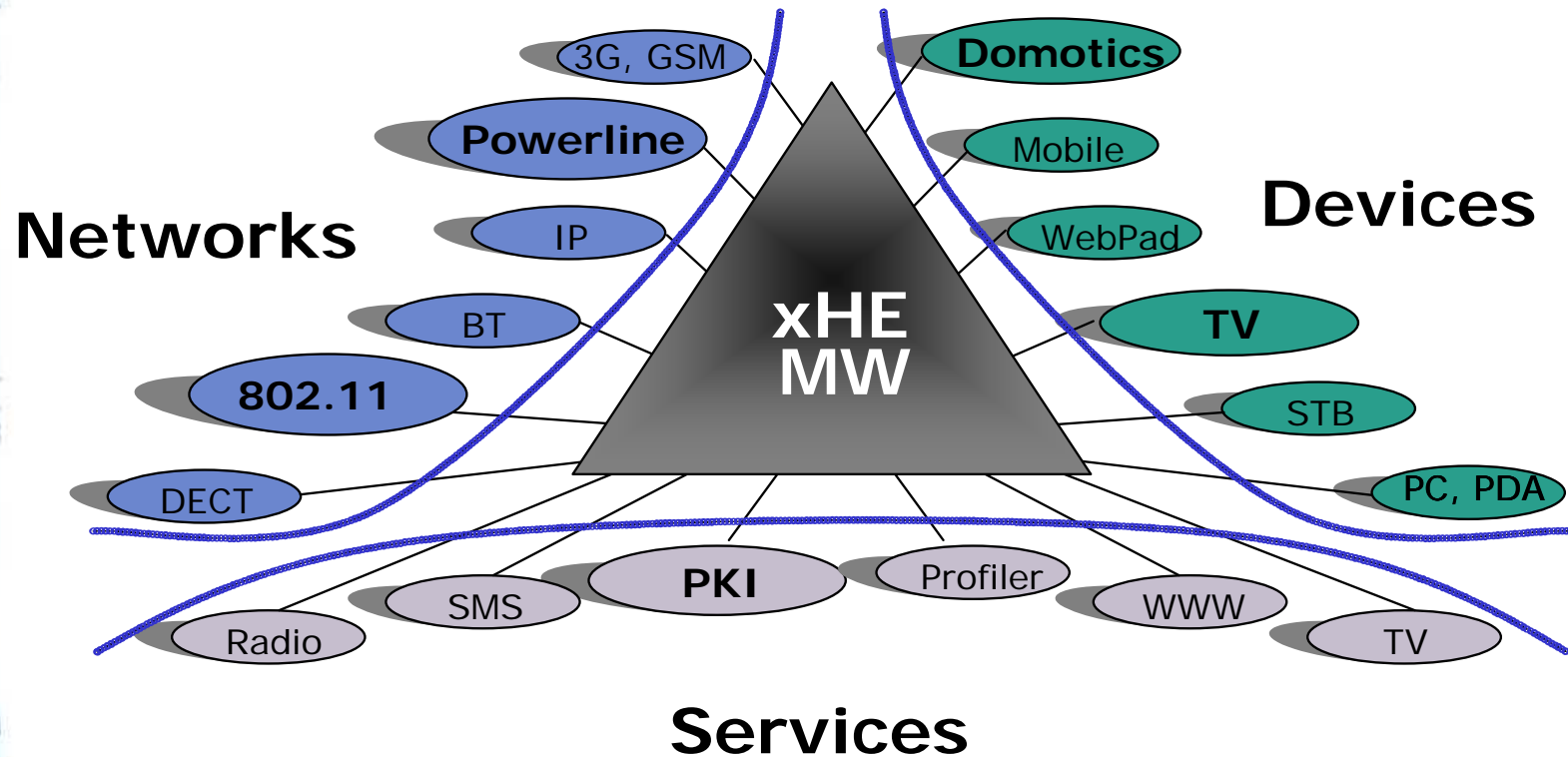
Architecture:
Components xHE

xHE HS
Home Server (controls access to xHE-CDs)

Network

xHE AD

PDA

Web Pad

xHE CD
Controllable Device (e.g. TV sets, VCR or other domestic appliances)

xHE CD

xHE AD
Access Device (e.g., a PDA or a cell phone; addresses and controls specific xHE-CDs)
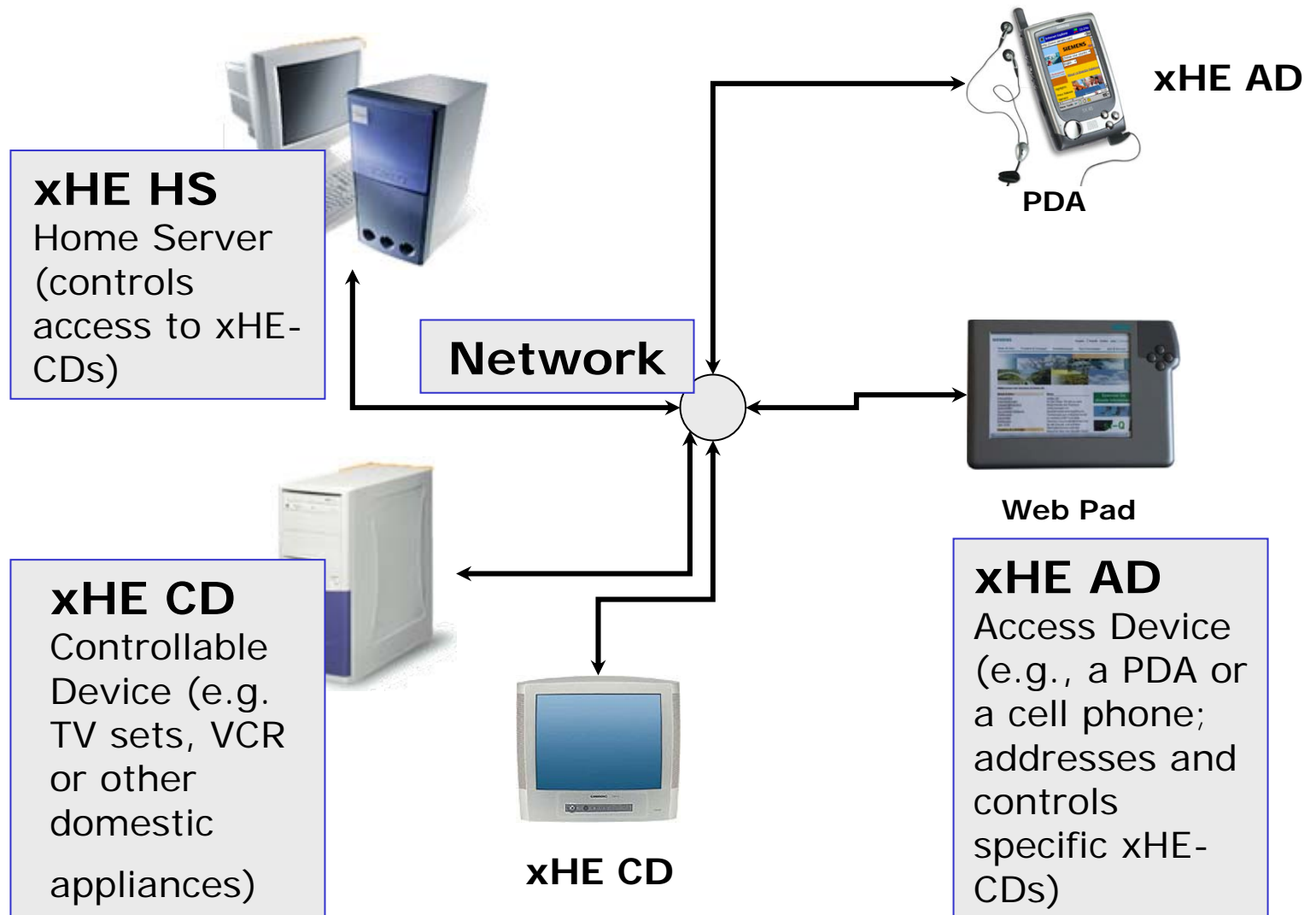
Architecture:
Adaptation & Personalisation

xHE HS

Device …

Central service to **adapt UI** access device (AD) capabilities.

Access Service

User Agent

Basic Authentication

Transcoder

User agent handling user **contexts and personalization**.

Device

Register

Device

Registry

UI ML

xHE CD

GSM / WLAN

PDA

http/ IP

PC

Web Pad

xHE AD
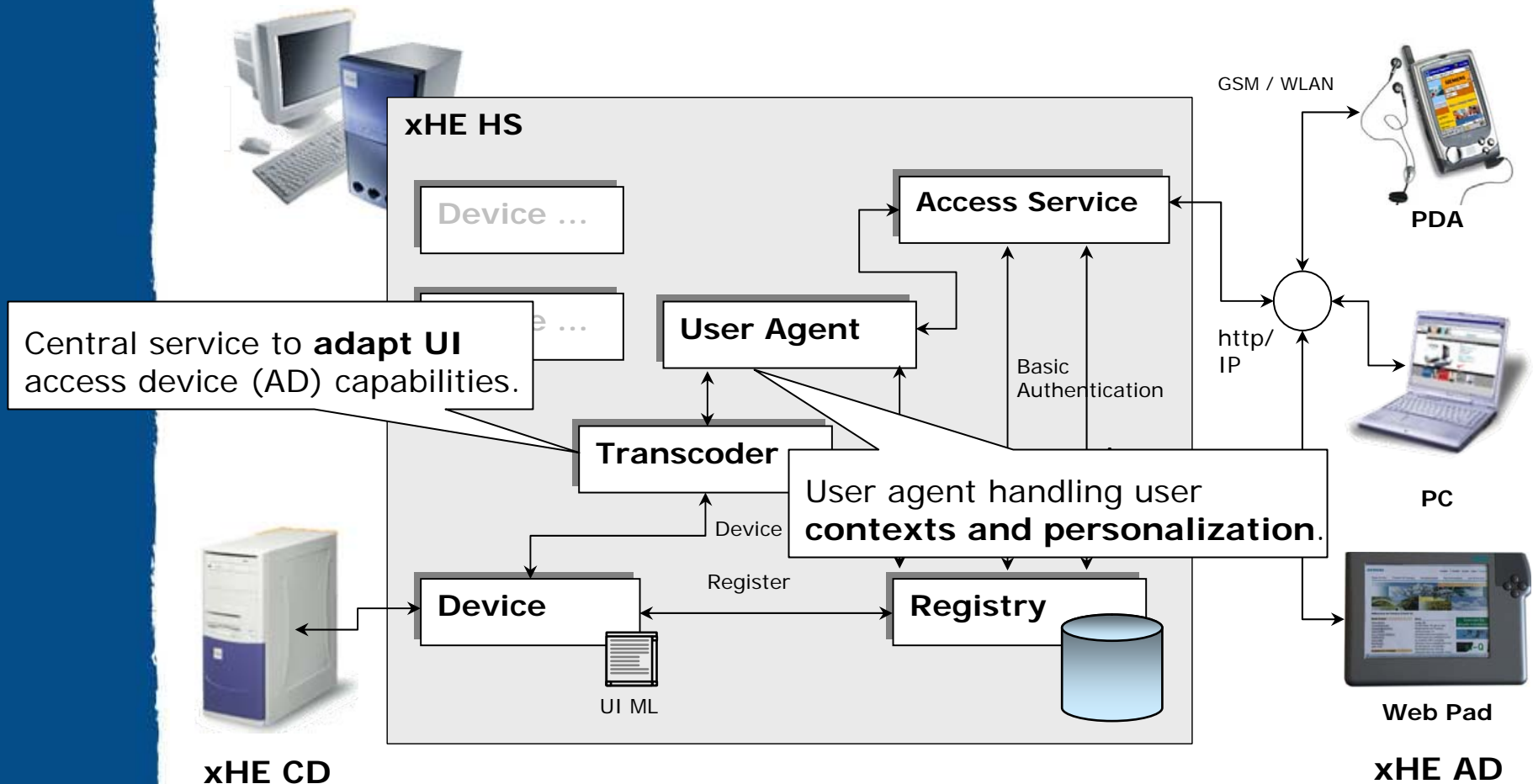
Prototype System:

OSGi-compatible HS

Open **S**ervices **G**ateway **i**nitiative:

◆ **Java** Technology for the web-based access to CDs

◆ xHE Components/Services -> Bundles
  - ◆ **Servlet** Packages in Java
  - ◆ Deployment to **central Server** (HS)

◆ Consideration of other Middleware Models:
  - ◆ HAVi, Jini, UPnP,…

◆ Different Products:
  - ◆ JES (Sun), ProSyst, IBM,…
  - ◆ OSCAR, JEFFREE, DC Server, Oxygen,…

Prototype System:
Deployment for *Mobile Display*
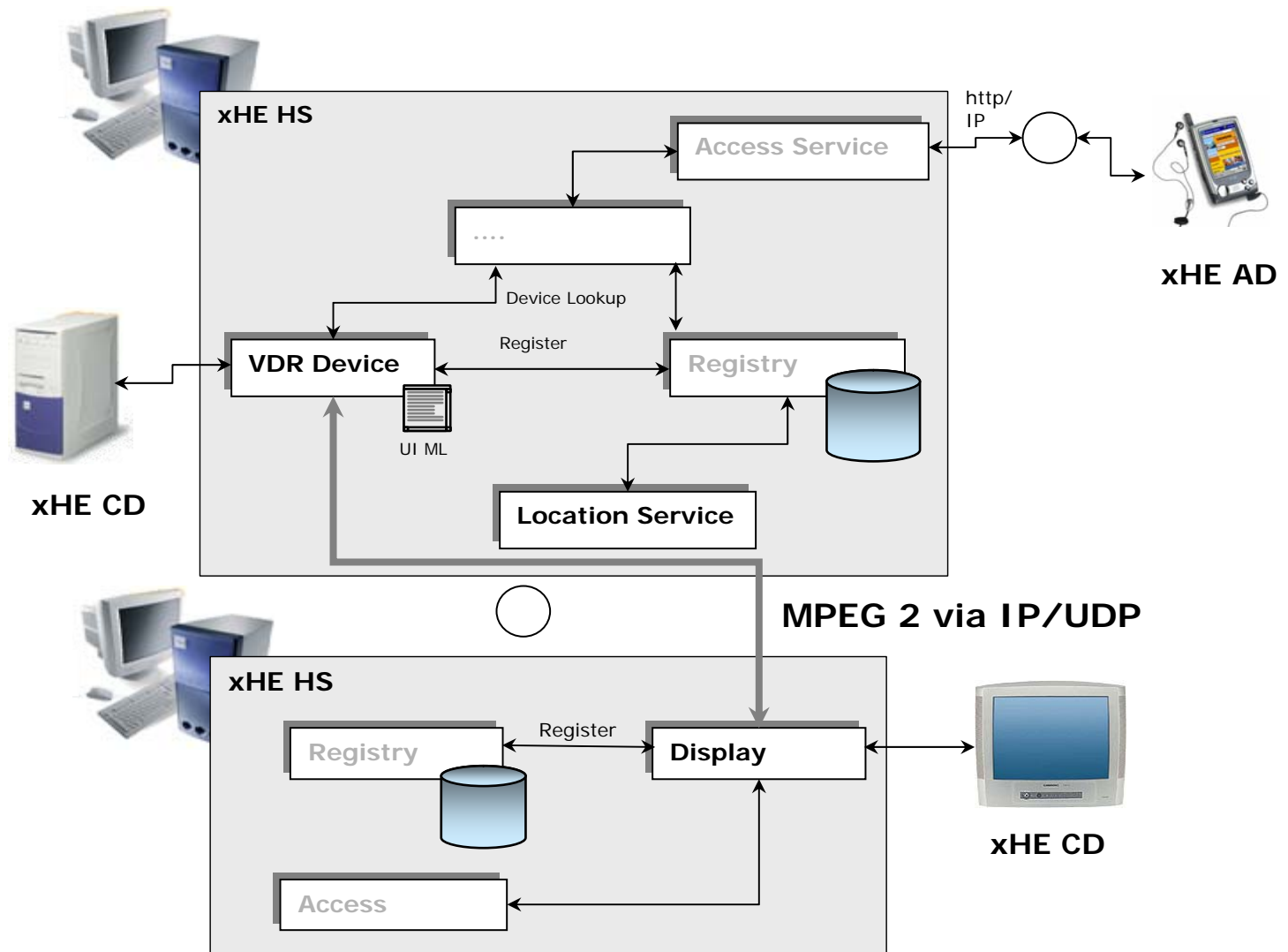
Prototype System:
Deployment *Follow-Me Display*

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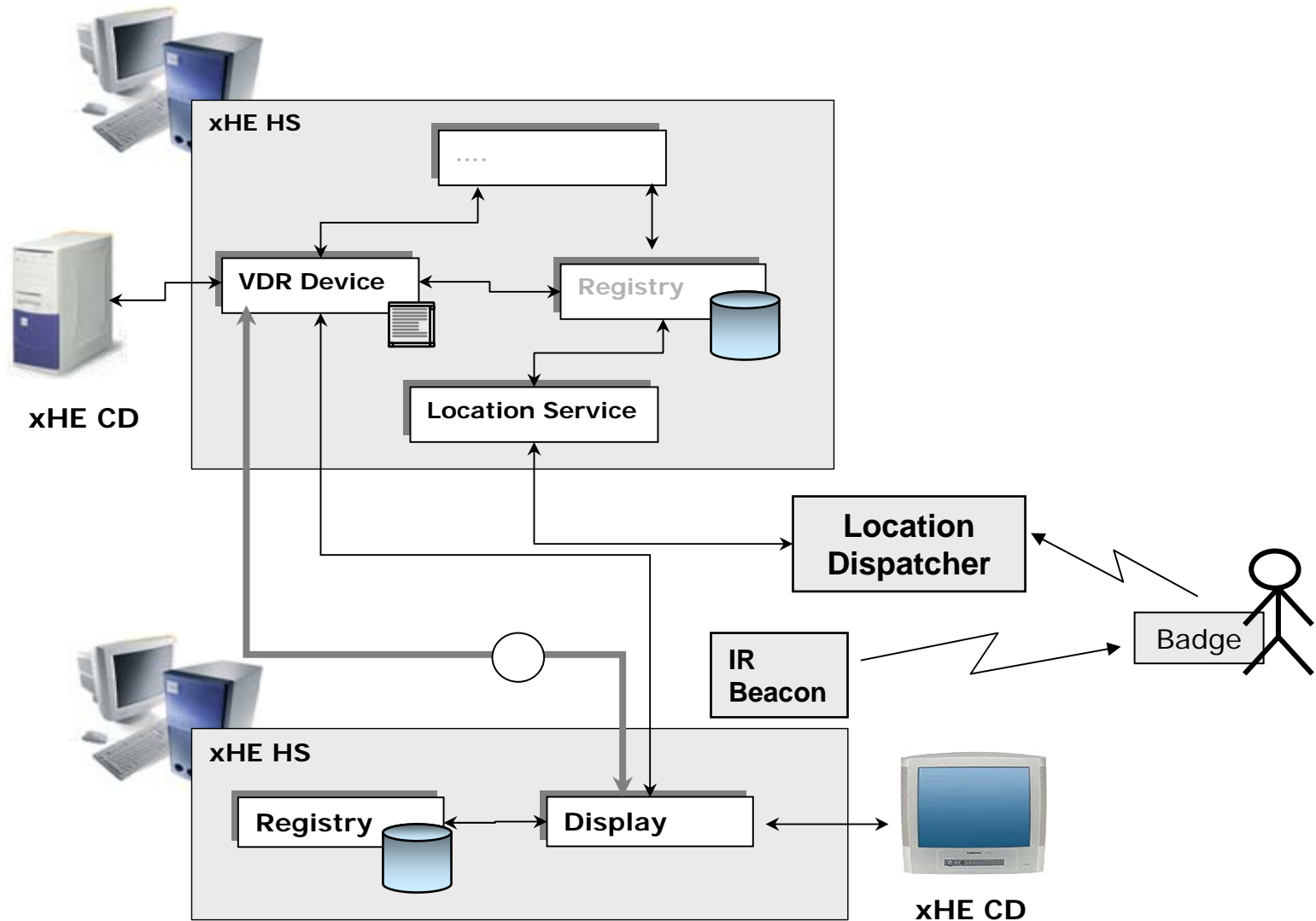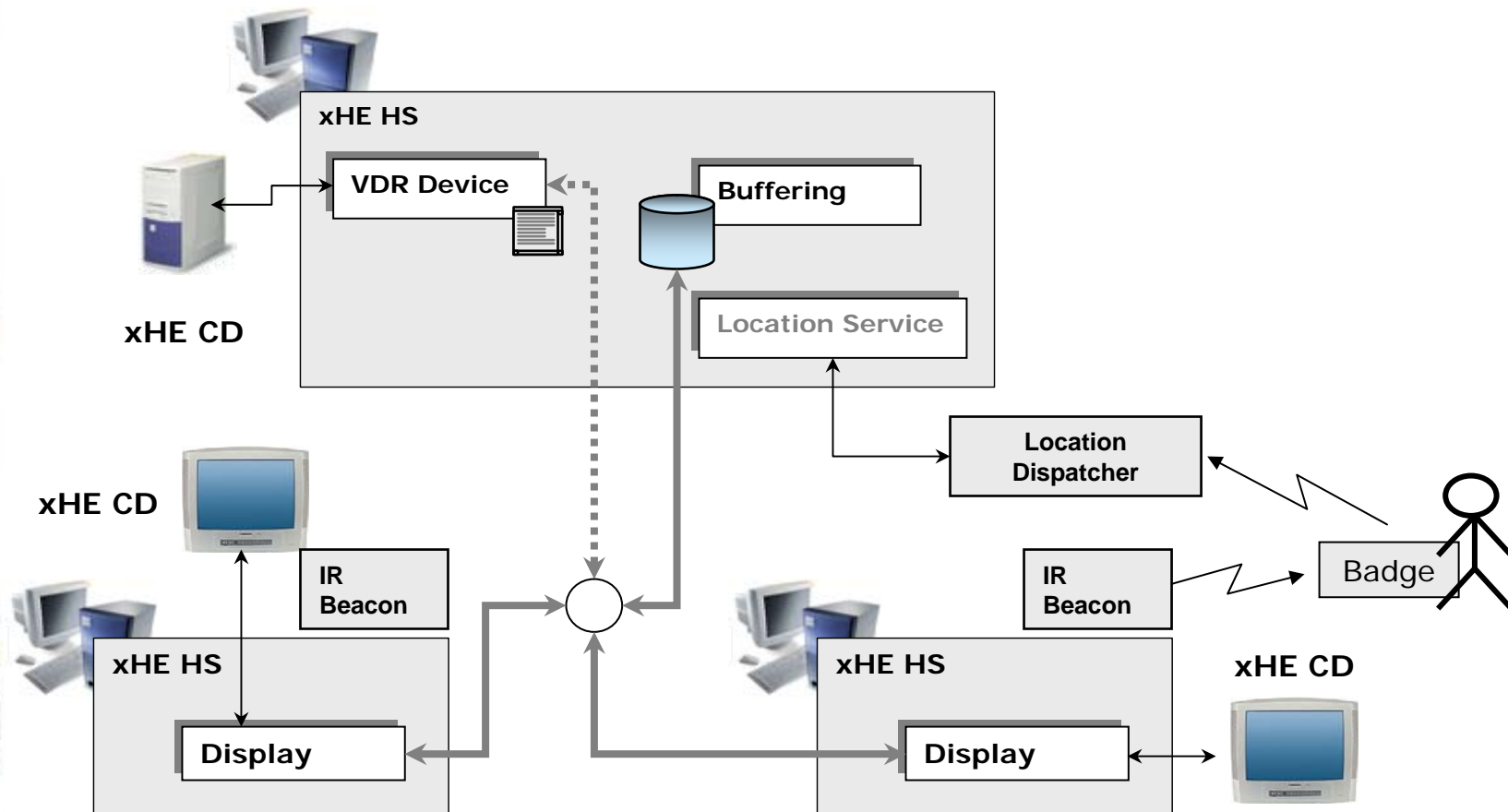
Prototype System:
Java Board Tini

◆ Dallas Semiconductors
◆ Platform for small/tiny network-enabled applications
  ◆ serial communications, 10Mb Ethernet, Controller Area Network and 1-Wire
  ◆ JAVA programmable
  ◆ TBM390 ca. 50$ + socket board
◆ -> Platform for HW Gateway

Prototype System:
Streaming & Timeshift Playout

Handling of streamed & recorded content:

◆ Handling of different client applications:
Windows Media, JMF, MPlayer, Elecard,…

◆ Platforms: Linux, Windows 2k

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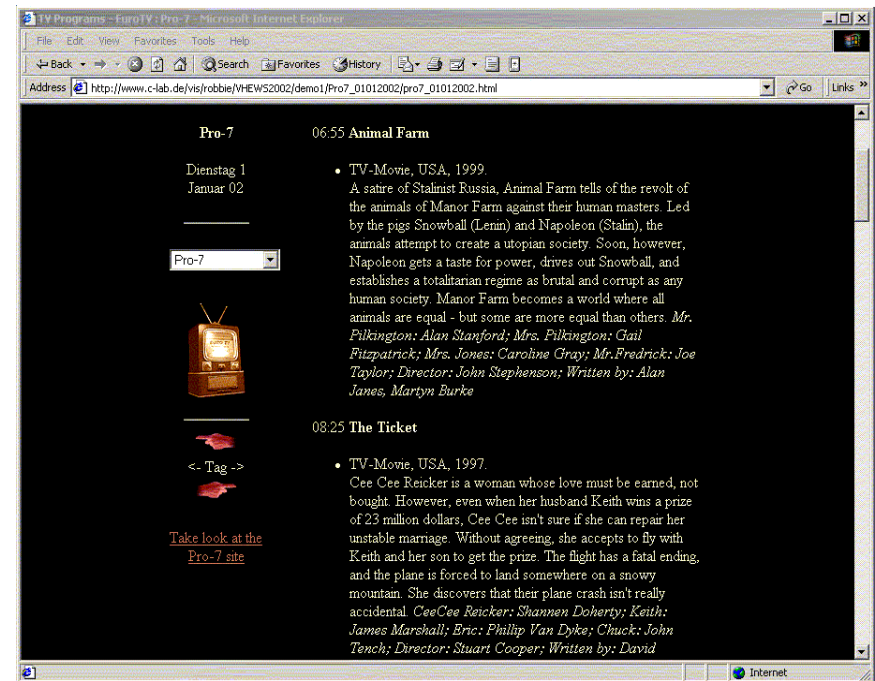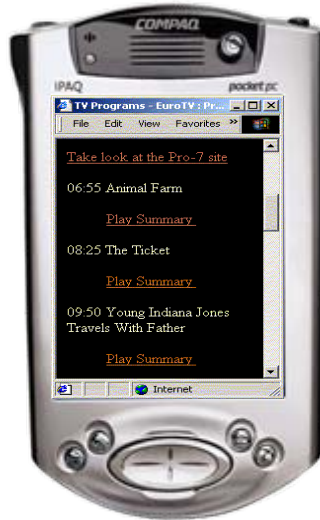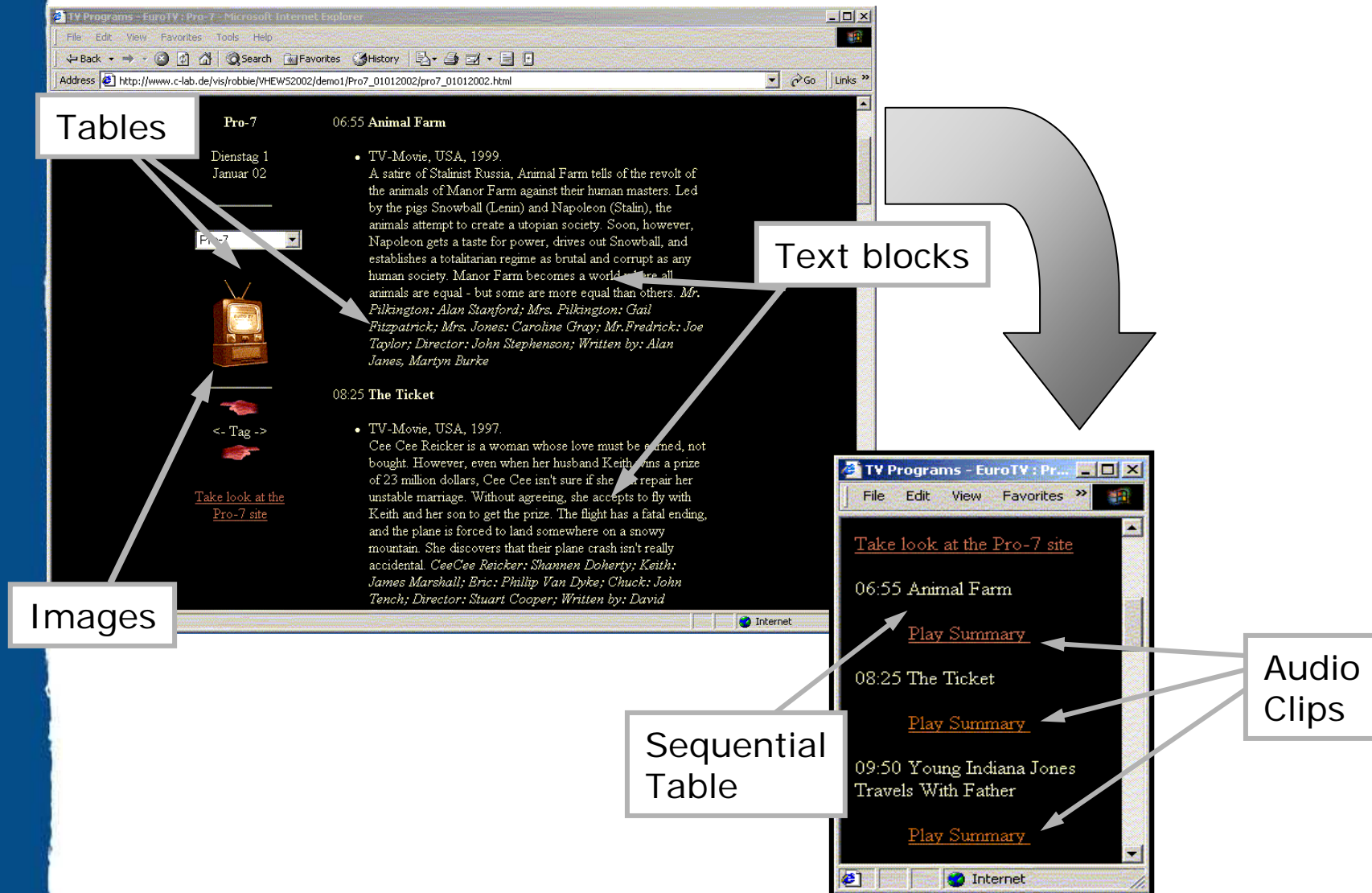
Prototype System:
Additional Options

Additional Services:
- ◆ Personalisation of VDR Settings (Channel selections) via **SmartCard**
- ◆ **Portability**: HS-based profile (e.g. Playlist) to be used in car / office
- ◆ Distributed Media Archive utilising **Peer-2-Peer** technology (JXTA)

- ◆ ...
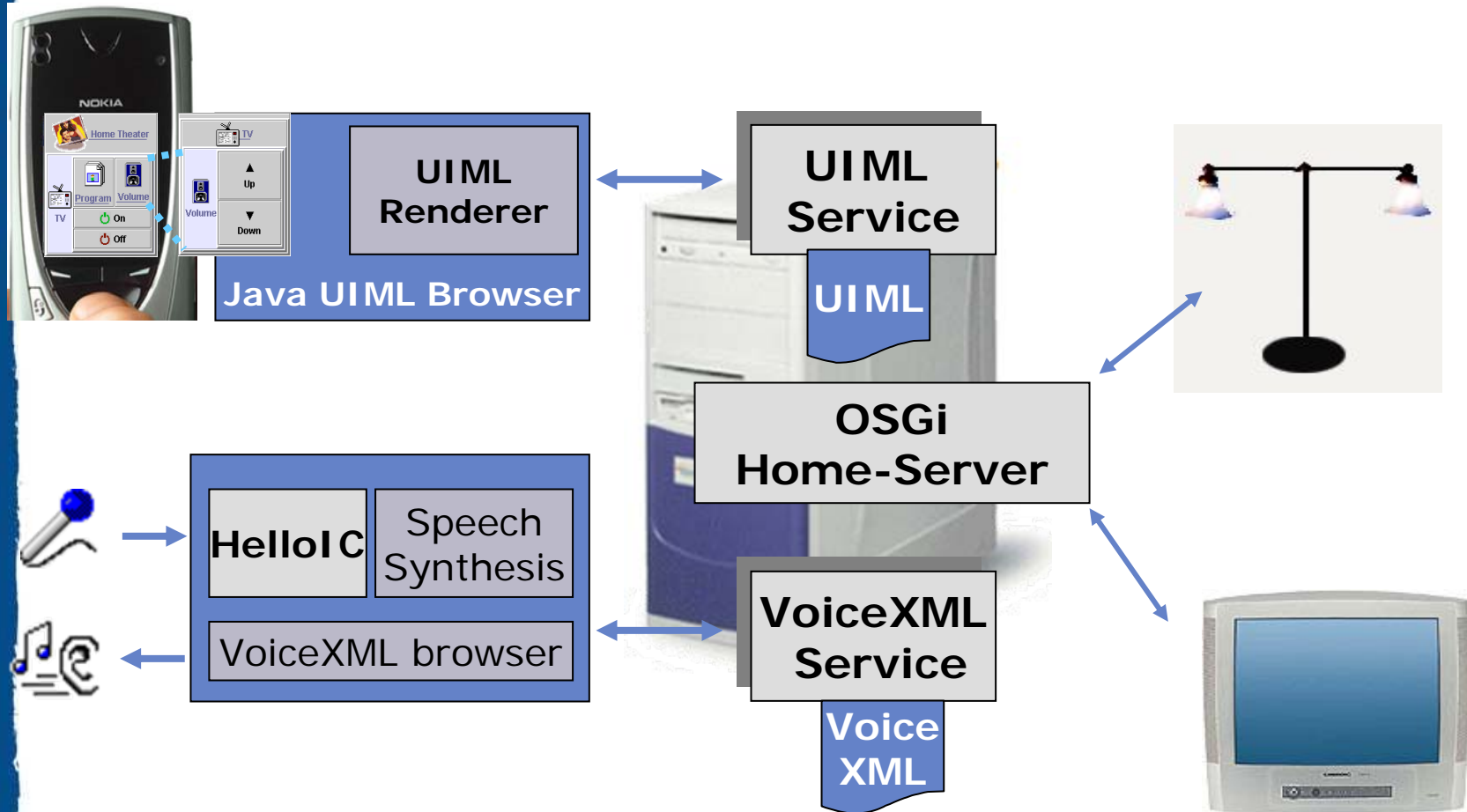- ◆ **Transcoding** for different xHE-ADs using XML

UI Technologies:
Adaptation through Transcoding

UI Technologies:
Adaptation through Transcoding

Tables

Text blocks

Images

Sequential Table

Audio Clips

UI Technologies:
Targeted UI-Middleware Technologies

UIML Renderer

Java UIML Browser

HelloIC | Speech Synthesis

VoiceXML browser

UIML Service

UIML

OSGi Home-Server

VoiceXML Service

Voice XML

Data Management:
Peer-to-Peer Communications